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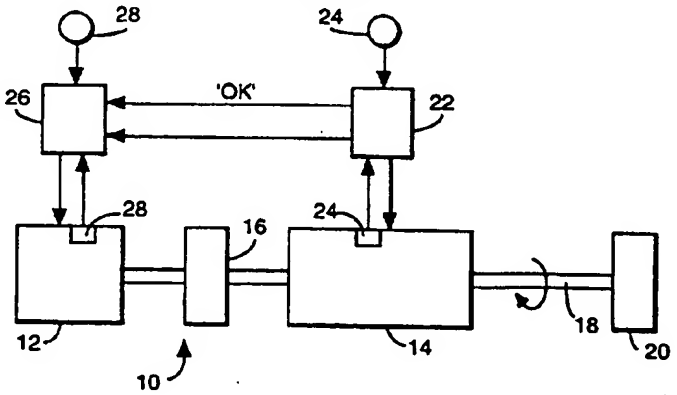
(54) Limiting engine torque during fault in automatic transmission.

(57) A method of controlling the output torque from an engine 12 in a motor vehicle having an automatic transmission 14, an engine control module 26 controlling the operation of the engine, and a transmission control module 22 controlling the operation of the automatic transmission, the method comprising the steps of generating a signal 'OK' in the transmission control module at predetermined intervals indicating that the transmission control module is operating correctly; sending the signal from the transmission control module to the engine control module; monitoring the signal from the transmission control module by the engine control module; and preventing the maximum output torque from the engine from exceeding a predetermined level when the signal is not received by the engine control module. Reduces risk of excessive engine torque damaging the transmission.

Fig.1.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.

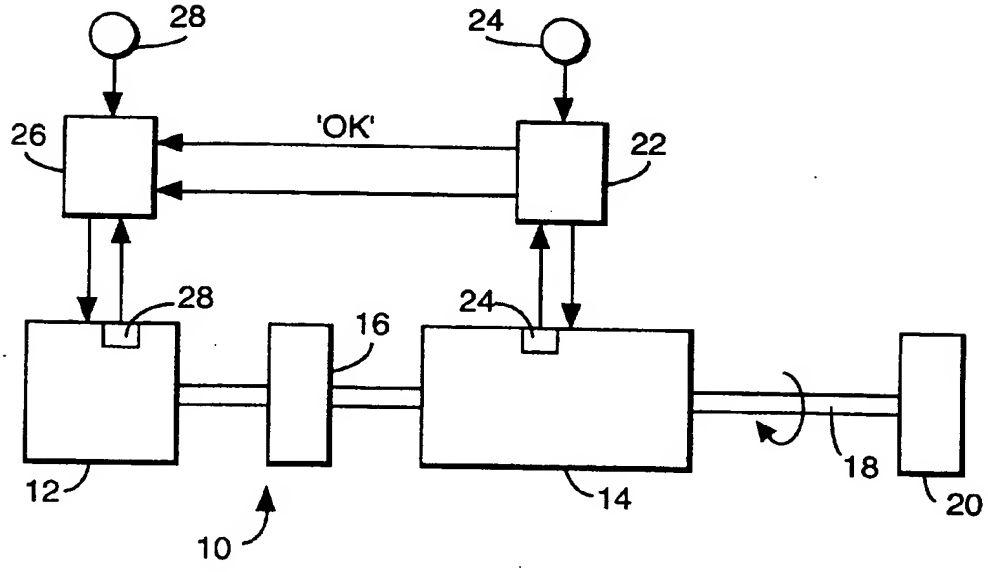

28
24
26
'OK'
22
28
16
24
12
14
18
20
10

Fig.2.

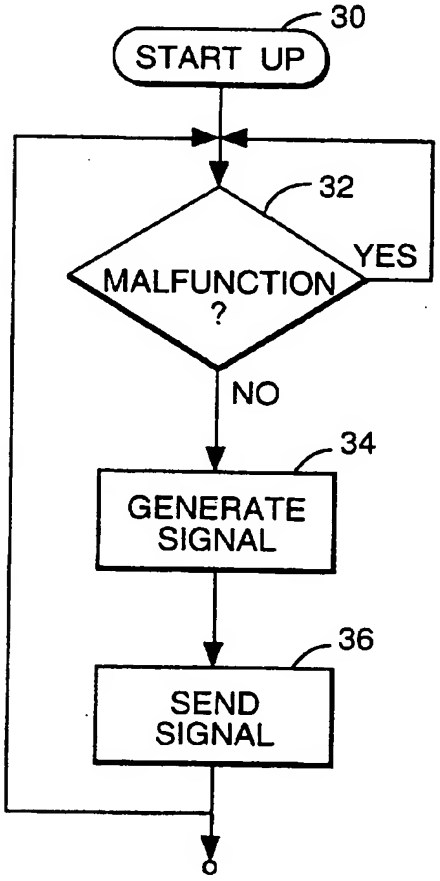
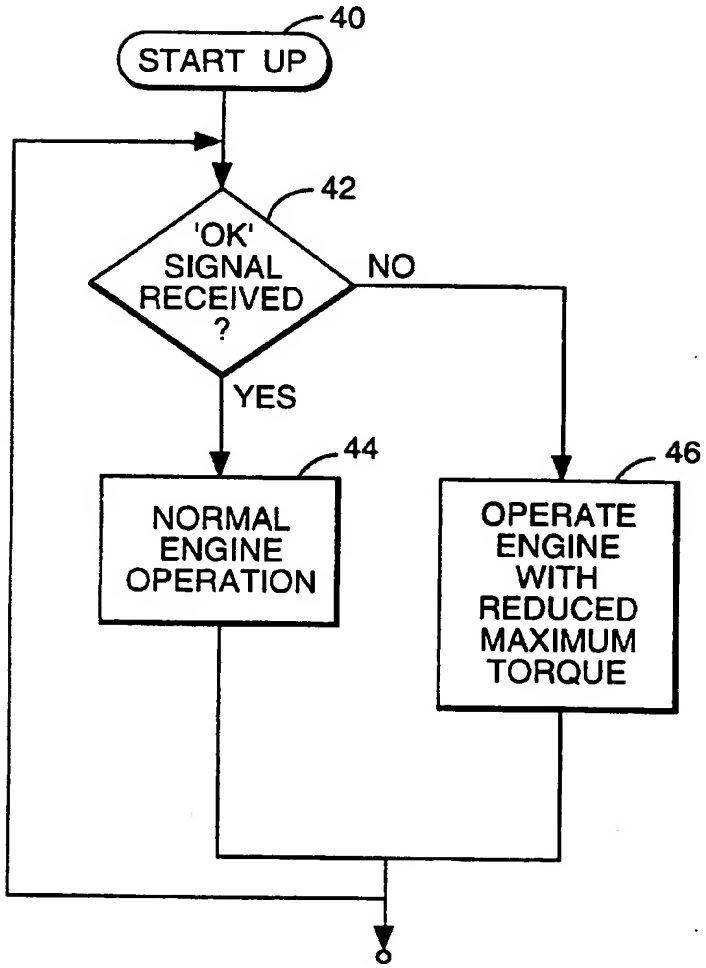

30
START UP
32
MALFUNCTION ?
YES
NO
34
GENERATE SIGNAL
36
SEND SIGNAL

Fig.3.


40
START UP
42
'OK' SIGNAL RECEIVED ?
NO
YES
44
NORMAL ENGINE OPERATION
46
OPERATE ENGINE WITH REDUCED MAXIMUM TORQUE

ENGINE TORQUE CONTROL

The present invention relates to a method of controlling the output torque from an engine in a motor vehicle having an automatic transmission.

It is known in a motor vehicle to have the operation of an internal combustion engine controlled by an engine control module (ECM), typically in the form of a microprocessor. It is also known to have the operation of an automatic transmission controlled by a transmission control module (TCM), typically also in the form of a microprocessor. The ECM receives input signals from various sensors on the motor vehicle and sends output signals to the engine to adjust the injection time and/or injection quantity, and/or change the spark advance, to adjust the output torque from the engine dependent on the input signals. Similarly, the TCM receives input signals from various sensors on the motor vehicle and sends output signals to the transmission to control gear shifts and/or line (hydraulic fluid) pressure in the transmission. The TCM also sends a signal to the ECM to reduce the output torque from the engine during a gear shift in the transmission. This arrangement allows the automatic transmission to transmit high torque in a short time for improved gear shift quality. This arrangement also allows the output torque of the engine to be limited during any abusive operation of the motor vehicle by the vehicle operator. A problem can arise with this arrangement where the maximum possible output torque from the engine is in excess of the torque capacity of the automatic transmission, and there is a failure or malfunction in the TCM. This situation risks excessive

torque being supplied by the engine to the automatic transmission, with the possibility of damaging the automatic transmission.

It is an object of the present invention to overcome this problem.

To this end, a method in accordance with the present invention of controlling the output torque from an engine in a motor vehicle having an automatic transmission, an engine control module controlling the operation of the engine, and a transmission control module controlling the operation of the automatic transmission, comprises the steps of generating a signal in the transmission control module at predetermined intervals indicating that the transmission control module is operating correctly; sending said signal from the transmission control module to the engine control module; monitoring said signal from the transmission control module by the engine control module; and preventing the output torque from the engine controlled by the engine control module from exceeding a predetermined level when said signal is not received by the engine control module.

With the present invention, the engine control module can detect when there is a failure of the transmission control module to operate or to operate correctly, and can reduce the maximum output torque from the engine to a level which does not exceed the torque capacity of the automatic transmission.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic presentation of the drive train of a motor vehicle in which the method of the present invention is used;

Figure 2 is a flow diagram of the operation of the transmission control module in accordance with the present invention; and

Figure 3 is a flow diagram of the operation of the engine control module in accordance with the present invention.

Referring to Figure 1, the drive train 10 of a motor vehicle comprises an internal combustion engine 12 which supplies output torque to an automatic transmission 14 by way of a torque converter 16, the automatic transmission having an output shaft 18 which provides drive to a final drive unit 20 (typically a differential unit). The final drive unit 20 provides drive to the driven wheels (not shown) of a motor vehicle. The operation of the automatic transmission 14 is controlled by a transmission control module (TCM) 22, in the form of a microprocessor, which receives input signals from various sensors 24 mounted on the motor vehicle and in/on the automatic transmission. The operation of the engine 12 is controlled by an engine control module (ECM) 26, in the form of a microprocessor, which receives an input signal from the TCM 22 and input signals from various sensors 28 mounted on the motor vehicle and in/on the engine. The TCM 22 sends signals to the automatic transmission 14 to control gear shifts (by controlling the operation of friction devices, brakes and clutches, within the automatic transmission) and/or line (hydraulic fluid)

pressure in the automatic transmission dependent on the sensed input signals. The ECM 26 sends output signals to the engine 12 to adjust the injection time and/or injection quantity, and/or change the spark advance, to adjust the output torque from the engine dependent on the sensed input signals. The signal from the TCM 22 to the ECM 26 indicates an imminent gear shift so that the engine output torque is control to provide a smooth gear shift. The arrangement as thus far described is known to those skilled in the art and will not be described in further detail.

In accordance with the present invention, the TCM 22, after initial start up (step 30, Figure 2), checks for any malfunctions (step 32) in the TCM, such as a malfunction at an input or an output of the TCM, which could affect the correct operation of the TCM. If no malfunctions are detected, the TCM 22 generates an 'OK' signal (step 34) and sends this signal (step 36) to the ECM 26. The TCM 22 then returns to repeat step 32 and the subsequent steps. If a malfunction is detected at step 32, the TCM 22 returns to repeat step 32. With this arrangement, an 'OK' signal is sent to the ECM 26 at predetermined intervals if the TCM 22 detects that it is operating correctly. The predetermined interval can be set by a counter (not shown) associated with the TCM 22 which is incremented by a clock. If the TCM 22 detects that there is a malfunction, or if there is a total operational failure of the TCM 22, no 'OK' signal is sent to the ECM 26.

The ECM 26, after initial start up (step 40, Figure 3), checks (step 42) for receipt of an 'OK' signal from the TCM 22, or checks for a predetermined sequence of 'OK' signals from the TCM. If such a signal or sequence of signals is received, the ECM 26 controls (step 44) the operation of the engine 12 to provide a full range of output torques from the engine. If such a signal or sequence of signals is not received, indicating a malfunction of, or failure of, the TCM 22, the ECM 26 controls (step 46) the operation of the engine to limit the maximum output torque from the engine to a predetermined level which is equal to, or less than, the known torque capacity of the automatic transmission 14. The value of the torque capacity of the automatic transmission 14 is stored in a ROM (not shown) associated with the ECM 26. The control step 46 may include any one or more of adjusting fuel injection timing, adjusting fuel injection quantity, and changing spark advance of the spark plugs (not shown) in the engine. The ECM 26 repeats steps 42 and 44 or steps 42 and 46 at predetermined intervals to provide a substantially continuous monitoring of the state of the TCM 22. The predetermined interval can be set by a counter (not shown) associated with the ECM 26 which is incremented by a clock. The monitoring predetermined interval associated with the ECM 26 is preferably greater than the 'OK' signal sending predetermined interval associated with the TCM 22.

With the method of the present invention, the automatic transmission 14 is substantially protected from

potential damage from excessive output torque from the engine 12 during a malfunction of, or failure of, the TCM 22.

Claims:

1. A method of controlling the output torque from an engine in a motor vehicle having an automatic transmission, an engine control module controlling the operation of the engine, and a transmission control module controlling the operation of the automatic transmission, the method comprising the steps of generating a signal in the transmission control module at predetermined intervals indicating that the transmission control module is operating correctly; sending said signal from the transmission control module to the engine control module; monitoring said signal from the transmission control module by the engine control module; and preventing the maximum output torque from the engine controlled by the engine control module from exceeding a predetermined level when said signal is not received by the engine control module.

2. A method as claimed in Claim 1, wherein the engine control module monitors said signal from the transmission control module at predetermined intervals.

3. A method as claimed in Claim 1 or Claim 2, wherein the engine control module monitors a predetermined sequence of said signals from the transmission control module.

4. A method substantially as herein described with reference to the accompanying drawings.